



Earth Science

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Volcanoes and Yucca Mountain

Yucca Mountain was formed millions of years ago by a series of explosive volcanic eruptions. These eruptions deposited ash and material which compressed together to create layers of rock called tuff. The explosive type of volcano that formed Yucca Mountain is extinct. There are, however, seven small and dormant volcanoes that scientists are studying in the Yucca Mountain area to determine if one might erupt in the next 10,000 years, and if an eruption might affect an underground nuclear waste repository. By studying the layers of soil and rock to learn about past volcanic activities, scientists can make predictions about the future.

Scientists called volcanologists have been studying volcanoes at Yucca Mountain for more than a decade. They believe that the probability of a volcano erupting in the Yucca Mountain region over the next 10,000 years is very remote and does not make the site unsuitable for a repository. The chance of a volcano directly affecting a repository in the Yucca Mountain area has been calculated as about one in 70 million per year.

The seven volcanoes located near Yucca Mountain are among the most common type of volcano on earth. One cone is located about 20 kilometers (12 miles) away, and may have been active within the last 75,000 years. The other six, located 13 to 43 kilometers (8 to 27 miles) away, had their last eruptions from 385,000 years to one million years ago.

Three types of volcanoes

There are three main types of volcanoes:

composite, shield, and cinder cones. Composite volcanoes have explosive eruptions. Shield volcanoes have less explosive eruptions, and people can walk fairly close to slow-moving lava from these volcanoes. The Hawaiian islands are examples of shield volcanoes. Of the three main types of volcanoes, cinder cones generally are the smallest, with the simplest and weakest eruptions. The seven dormant volcanoes near Yucca Mountain are cinder cones.

Different types of volcanic eruptions

When discussing volcanoes, it helps to know about different types of eruptions. The eruption type depends mainly on the amounts of water and the compound called silica present in the magma beneath a volcano. Magma is a mixture of gas bubbles, crystals, molten rock, and fragments of rock that form deep inside the earth. The amount of silica determines how fluid the magma is, as well as the final chemical composition of the rock formed from the magma. The amount of water, which is in a gaseous state within the magma, determines the force or explosiveness of the eruption.

If the magma has a high silica content, it is silicic (explosive) and erupts explosively, like a gushing soda pop bottle. The magma is thrown high into the atmosphere where it cools in the air and falls to earth as a blanket of ash. Over



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time, the ash consolidates and forms a highly porous rock called ash-fall tuff.

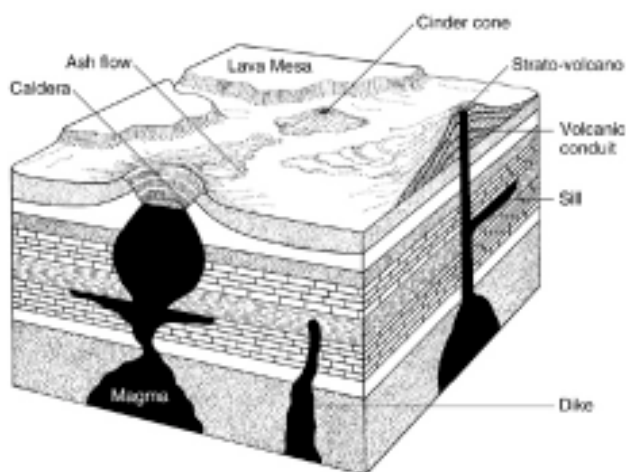
A smaller amount of silica and water, in which less magma mixes with air, causes a less explosive eruption. More magma flows out at ground level and the temperature remains high over a longer period of time. Much of the magma and ash welds into dense, non-porous rock called ash-flow tuff.

When the magma has a low silica content, it's called basaltic. Basaltic volcanoes have relatively nonexplosive eruptions that throw little magma or material into the atmosphere. Instead, the magma usually flows quietly out of the volcano and onto the ground. When this magma cools, it forms lava or cinders, depending on how it was erupted. The cinder cones near Yucca Mountain are basaltic.

How was Yucca Mountain formed?

Yucca Mountain itself was formed from multiple eruptions of a special type of composite volcano called a caldera. Calderas form when large volumes of magma erupt rapidly. The underground support for the volcano is removed, the surface then collapses and forms a circular depression, or caldera. Calderas can range in size from a few miles to tens of miles across.

Four major layers of ash-flow tuff were deposited at Yucca Mountain 12 million to 15 million years ago interspersed with minor ash-fall layers. The events that formed these layers produced more than 1,000 cubic kilometers (600 cubic miles) of silicic magma. The



Typical volcanic features of the Yucca Mountain area

layers alternate from relatively non-porous rock to highly porous, depending on the extent of welding, and how fast the layers cooled. The volcanic tuff at Yucca Mountain is at least 1.8 kilometers (6,000 feet) thick.

About 1,000 feet below the surface of Yucca Mountain is a densely welded rock formation known as the Topopah Spring welded tuff. This ancient layer is being studied as a possible site in which to build a repository.

Will a volcano erupt in the next 10,000 years?

The last eruption from an explosive composite volcano occurred eleven million years ago. Timber Mountain, the explosive volcano that formed Yucca Mountain, is extinct.

Volcanologists believe the potential for a nonexplosive cinder cone volcano to erupt during the next 10,000 years is very small. When studying the past, volcanologists see that nonexplosive eruptions, or what scientists call basaltic eruptions, have occurred at Yucca Mountain only every 200,000 to 300,000 years. Scientists estimate that it is very unlikely that any of the seven cinder cones will erupt in the next 10,000 years.

Scientists will spend more than a decade at Yucca Mountain studying whether volcanoes or other geologic events might affect a repository. They will use geologic samples and geophysical methods to get the data they need.



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